



Welcome

to the Fourth Annual
Great Divide Workshop

Welcome to Great Falls and the Fourth Annual Great Divide Workshop. Our goal is to bring together meteorologists and hydrologists to share ideas and information so that we may all gain more understanding of the science and better serve the public. I hope you find our meeting enjoyable and informative. We look forward to seeing you again. Thanks for your participation!

– Ken Mielke
MIC WFO Great Falls

Program Committee:

John Blank and Paul Eyssautier, *co-chairmen*
Jeff Johnson, Jim Brusda, and Don Britton

Thanks for a job very well done!

Also, special thanks to Wanda Hale for all of the behind-the-scenes support given to this workshop.

Fourth Annual Great Divide Workshop

Great Falls, Montana

AGENDA - TUESDAY, SEPTEMBER 12

2:00 PM Workshop Welcome/Logistics
 -Ken Mielke
 -Vickie Nadolski

Session 1: Hydrology - Measurements/Modeling - *Charlotte Camp*

2:15 PM Airborne and Satellite Snow Cover Data used by the National Operational Hydrologic Remote Sensing Center
 -Tom Carroll (NOHRSC)

3:00 PM The Future of the Western Region Hydrology Program
 -Bob Tibi (Hydrologic Services Division - WRH)

3:20 PM Application of a One-Dimensional Model and GIS in the Mackenzie Delta
 -Vir Khanna (Environment Canada)

– Break –

4:00 PM Use of a Distributed Hydrology Model for River Forecasting in Western Washington
 -Doug McDonnal (WFO Seattle)

Session 2: Satellite Training - *Dave Bernhardt*

4:20 PM Satellite Meteorology Training for the Operational Weather Services
 -Moving to Distance Training
 -Anthony Mostek (Office of Meteorology - COMET/UCAR)

4:40 PM Using Satellite Imagery for Nowcasting in a High Plains, Weakly-Sheared Environment
 -John Weaver (CIRA Colorado State University)

– ADJOURN –

6:00 PM No Host Bar

7:00 PM Banquet -
 Recent Climate in the Big Sky Country: Something New under the Sun?
 -Kelly Redmond (Western Region Climate Center)

8:00 AM Development of New, Prototype WSR-88D Products and Algorithms
-Robert Maddox (National Severe Storms Laboratory/
CIMMS University of Oklahoma)

8:35 AM Western U.S. Radar Issues
-John Ferree (Operational Support Facility - Training Branch)

8:55 AM Challenges Facing Media Forecasters in the Northern Rockies
-Eric Gardner (KTWO-TV, Cheyenne WY)

9:15 AM Dispatch Cards
-John Weaver (CIRA Colorado State University)

9:35 AM Severe Convective Outbreak in Northeastern Montana (July 21, 1999)
-Eugene Petrescu (WFO Glasgow)

– Break –

10:20 AM Pine Lake Tornado
-Dan Kulak (Environment Canada)

10:40 AM A Thunderstorm Event in Central Montana
-James Brusda (WFO Great Falls)

11:10 AM Areal Mean Basin Estimated Rainfall (AMBER)
-Gregg Rishel (Hydrologic Services Division - WRH)

11:30 AM Effects of Wildfire on Hydrology
 -Steve King and Steve Ghode (Northwest River Forecast Center)

– Lunch –

1:00 PM Operational Workshop (all participants invited)
 - Predicting a Complex High Plains Spring Storm
 -Don Moore (WFO Spokane)

– Break –

Session 5: Weather Monitoring - *Bob Benjamin*

2:15 PM Monitoring Weather Conditions over the Western United States
 -John Horel (University of Utah)

2:50 PM Quality Control of SNOTEL Temperature Data and RAWS Data Access
 -Kelly Redmond (Western Region Climate Center)

3:20 PM Meteogram Guidance Study
 -Beth McNulty (WFO Glasgow)

– Break –

Session 6: Operational Hydrology Issues - *Jim Brusda*

4:05 PM Northeast Montana Hydrology: An Overview and Methodology
 -David Secora (WFO Glasgow)

4:25 PM River Ice Jams
 -Charlotte Camp (WFO Great Falls)

4:45 PM The 1997 South Central Montana Flood Season: A Record Setter
 -Sally Springer (WFO Billings)

– ADJOURN –

Session 7: Winter Weather/Fog Topics - *John Blank*

8:00 AM Case Study of a Persistent Cold Pool in the Helena Valley
-Jeff Johnson (WFO Great Falls)

8:20 AM A Case Study of Dense Fog over Southern Montana
 -Rick Canepa (WFO Billings)

8:40 AM A Climatology of Freezing Rain in the Columbia Basin
-Ronald Miller (WFO Spokane)

9:00 AM An Investigation of Favorable Conditions for Heavy Snow over the Washington North Cascades' East Slopes
-Don Moore (WFO Spokane)

– Break –

Session 8: Training/Fire Weather/Verification - Doug Vogelsang

9:45 AM Aviation Program Web Based Study Training Modules
-Beth McNulty (WFO Glasgow)

10:05 AM The Halloween 1999 Northeast Montana Firestorms
-Eugene Petrescu (WFO Glasgow)

10:25 AM Hydrologic Verification in Western Region
-Gregg Rishel (Hydrologic Services Division - WRH)

– ADJOURN –

Airborne and Satellite Snow Cover Data Used by the National Operational Hydrologic Remote Sensing Center

Tom Carroll
National Operational Hydrologic
Remote Sensing Center

The National Operational Hydrologic Remote Sensing Center (NOHRSC) is the National Weather Service (NWS) Center of expertise in satellite and airborne remote sensing and geographic information systems used to support the NWS operational hydrology program for the Nation. The center provides remotely sensed and GIS hydrology products, GIS applications, and spatial data sets in a format and time frame required to support various research, developmental, and operational hydrology programs conducted at the local, regional, and national scales. The most widely used Center products estimate snow cover properties with data collected by airborne, satellite, and ground-based sensors.

The Center operates two terrestrial gamma radiation detection systems on low-flying aircraft to infer snow water equivalent over a network of more than 1800 flight lines covering portions of 25 states and 7 Canadian provinces.

Analysts at the Center use image data from the Advanced Very High Resolution Radiometer (AVHRR) on the National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites and image data from the Geostationary Operational Environmental Satellites (GOES) to digitally map areal extent of snow cover for the 48 coterminous United States, Alaska, and those portions of southern Canada that drain into the U.S.

Additionally, analysts use geographic information system (GIS) technologies to integrate satellite, airborne, and ground-based observations of snow into gridded products of areal extent of snow cover and snow water equivalent. The Center develops products daily for regions of the U.S. and southern Canada.

The paper will discuss the techniques and procedures used to make, process, and distribute airborne snow water equivalent measurements in near real-time. Additionally, the use of satellite data to map areal extent of snow cover will be reviewed. Procedures to integrate ground-based, airborne, and satellite snow measurements into a gridded snow cover product in near real-time will be discussed. More complete and detailed information is provided on the NOHRSC web site at www.nohrsc.nws.gov

The Future of the Western Region Hydrology Program

Bob Tibi
Hydrologic Services Division
NWS Western Region
Headquarters

The mission of the Western Region hydrology program is to provide the best possible products and services to customers and partners. Toward this end, the program is attempting to leverage recent changes in operations and systems to develop more effective and efficient means of providing hydrologic products and services.

A major change in field operations related to the hydrology program will occur this year. That change will result from the decision of the NWS Corporate Board to no longer require WFOs to produce QPF and related forecasts for use in RFC hydrologic models. WR WFOs are expected to remain involved in the QPF process by coordinating the QPF with HPC and the RFCs and providing updates when necessary.

The Western Region Hydrology program is moving into the modernized operational environment. All WR offices have had a representative attend a workshop designed to promote the use of the RIVERPRO portion of WHFS. WRH continues to work with field offices and the other regions to define and prioritize enhancements to WHFS which will improve its usefulness. This fiscal year will see the release of AWIPS Build 5.0 which will contain some of these enhancements. Efforts are also underway to develop a replacement for the CADAS data collection system.

NWSH efforts to expand the Advanced Hydrologic Prediction Services (AHPS) project continue. Much of the NWSH efforts are geared towards securing funding for future deployment and development. The name of the project has been changed from System to Services to reflect an increased emphasis on providing customer services, rather than a suite of software. The intent of AHPS is to provide improved hydrologic services, which include a measure of uncertainty, to NWS customers and partners. AHPS demonstration projects are being conducted at all RFCs, including the MBRFC efforts on the Yellowstone River. An emphasis will be made in the coming year to define customer requirements for products and to determine the specific development work which will be required to meet these requirements.

Other projects related to the hydrology program will also be deployed in the coming months. An effort to improve the evaluation and response to potential flash flood situations is under development. AMBER (Areal Mean Basin Estimated Rainfall) will provide high resolution rainfall estimates over small watersheds for flash flood evaluation. Another ongoing project is the development of a verification program for hydrologic forecasts and products. Part of the program will be deployed within the coming year.

Application of One-Dimensional Model and GIS in the Mackenzie Delta

Vir K. Khanna,
Hydrologist, Environment
Canada

Daniel J. Wild,
Engineering Co-op Student,
University of Alberta

Jesse N. Jasper,
Head, Arctic Section,
Environment Canada

The Mackenzie Delta is the largest delta in Canada and second largest arctic delta in the world. The delta spans approximately 12,000 square kilometers, with 25 percent of its area covered by lakes. Its size makes it very difficult to obtain a complete hydrological picture of the delta from a limited density of gauging stations, so a computer simulation (One-D model) is used to provide detailed hydrological information about the delta.

Fourteen gauging stations were used in the modeling process, i.e., two upstream boundary stations, three downstream boundary stations, and nine gauging stations at key sites within the delta. The voids in the data obtained from the boundary condition sites were filled using regression analysis. The One-D model was then calibrated and validated for the Mackenzie Delta using the 1982-97 record period. The percentage standard error of estimates varied with season. Errors for spring breakup and summer were found to be within reasonable limits, whereas the errors for freeze-up and winter were found to be significantly high for some years. The amount of hydrological data produced by this study was so overwhelming that ArcView GIS (Geographical Information System) was selected to display the results to make it useful for a potential user.

ArcView GIS was used to produce a detailed map of the Mackenzie River Delta, from which all the files related to the One-D project could be accessed using point-and-click procedures. This provided a visual frame of reference and an interface to more easily run the One-D model. The hydrological longitudinal profiles, cross-sectional profiles, and all site-specific data could be accessed at any time from this interface.

Use of a Distributed Hydrology Model for River Forecasting in Western Washington

Doug McDonnal
National Weather Service,
Seattle, Washington

For the past two years, the National Weather Service in Seattle, Washington (WFO Seattle) has been using a distributed hydrology model as an operational tool for river forecasting and flood warning. This model is the result of a collaborative project between the University of Washington (UW) and WFO Seattle, supported by a Severe Weather Prediction Initiative (SWPI) grant and the UW's Puget Sound Regional Synthesis Model (PRISM) program.

The operational setup couples the Distributed Hydrology Soil Vegetation Model (DHSVM), with the meteorological output of the UW's real-time Penn State/NCAR mesoscale model (MM5). DHSVM provides a dynamic simulation of the spatial distribution of soil moisture, snow cover, evapotranspiration, and runoff.

During the 1998-1999 flood season the model domain consisted of the Snohomish River basin in western Washington, which includes 6 of WFO Seattle's 31 river forecast points. The model ran twice each day, at the 00Z and 12Z cycles, driven by the output from the real-time MM5. Several factors contributed to a bias in the model to overforecast runoff and route water downstream too quickly.

During the 1999-2000 flood season the model domain covered the Deschutes, Nisqually, Puyallup, Green, Cedar, Snohomish, Stillaguamish, and Sauk River basins. This area includes 18 of the 31 river forecast points. In addition to the twice-daily MM5-driven model runs, the model ran once each day (12Z cycle) using WFO Seattle's quantitative precipitation forecast. Also, WFO Seattle forecasters had the ability to make additional model runs as desired. The model's skill during this year was much improved; forecast accuracy was comparable to that of the Northwest River Forecast Center forecasts.

Satellite Meteorology Training for the Operational Weather Services - Moving to Distance Training

Anthony Mostek
National Weather Service
Office of Meteorology,
Boulder, CO

The Integrated Sensor Training Professional Development Series (IST PDS) represents a concerted effort by the NWS to bring together diverse training activities that have traditionally focused on individual sensors such as satellite, radar, and other observing systems. The IST PDS is supported by the Virtual Institute for Satellite Integration Training (VISIT), comprised of staff from the Cooperative Institute for Meteorological Satellite Studies (CIMSS), the Cooperative Institute for Research in the Atmosphere (CIRA), and the NWS training facilities. Both the NWS and NESDIS support the VISIT program.

VISIT and the IST PDS program are working together to make satellite meteorology distance training a reality. Through the development of various training materials, the operational forecaster and the on-station training officer can access a virtual classroom and laboratory. This virtual classroom is composed of a diverse and rapidly growing set of materials: tutorials, on-line classroom presentations, GOES gallery, Satellite Interpretation Discussions, technical attachments, and Web-based modules. The training materials are available to all NOAA and DOD offices with no restriction. The training materials are available at several locations on the Web. To help the training officers organize the materials, the various sites are easily accessed via the IST PDS page, the VISIT homepage: www.cira.colostate.edu/ramm/visit/visithome.asp, and the satellite meteorology class homepage: www.comet.ucar.edu/class/satmet/home.html. A VISITview teletraining lesson will be shown at the workshop to display the various animation functions available to the instructors and the students during the teletraining sessions.

Using Satellite Imagery for Nowcasting in a High Plains, Weakly-sheared Environment

John F. Weaver, John F.
Dostalek, and Lewis D.
Grasso

CIRA, Colorado State
University, Fort Collins, CO

Convective environments having; 1) moderate-to-high values of Convective Available Potential Energy [say 2,000 J/Kg, or greater, for mid-to-late spring or early summer] and 2) strong winds that veer and increase in strength from the surface to 2 or 3 km AGL [Storm Relative Environmental Helicity (SREH) values greater than, say, 200 (m/s)²], frequently produce long-lived supercell storms that move to the right of the mean cloud-layer wind. Frequently, the right-mover forms after the original storm undergoes a process call 'storm-splitting.' In this process, pressure gradients on the flanks of the original updraft enhance lift and produce two new updrafts, one of which moves off to the right, the other to the left. Generally, after completion of the splitting process, the left-moving updraft dissipates within 30 min, while the right-mover often continues on for 2-3 hr, or more.

Most forecasters are aware that severe thunderstorms (producing large hail, damaging winds and perhaps even tornadoes) can occur in environments with substantially less shear than that required to produce classical splitting storms and supercells. This paper presents a brief overview of a case in which left-moving thunderstorms formed in a weak-flow/weak-shear environment, where the mean wind from 0-6 km AGL was from 265 degrees at 19 kt, and the midday estimated SREH was less than 10 (m/s)². In this case, the right- and left-moving storms neither formed nor behaved in the classical manner. Rather, the left-movers developed along the northward advancing portion of the original storm's low-level outflow boundary. These left-moving storms were long-lived and produced severe weather at least as intense as their right-moving partners.

Recent Climate in the Big Sky Country: Something New under the Sun?

Kelly Redmond
Western Regional Climate
Center, Reno, NV

An early memory is the sight of the grand sweep of the plains of North America giving way to the jagged peaks etched on the western skyline of the upper Missouri. By no coincidence, this abrupt transition is mirrored in the dramatic and rapid reversals in the wind from north to south, like an undecided squirrel trying to cross the road...maybe. Montana has one of the most variable climates in the world, and holds many records for changeability. Trying to detect incremental changes in climate amidst this tumultuous background often resembles trying to hear a harp at a heavy metal concert. And yet, in recent winters, this ebb and flow has given way to a one-sided emphasis on longer columns of mercury sticking their necks out of the thermometer bulb. What are we to make of the recurrence of these “open” winters? Are we being set up for the climatic equivalent of a financial market “correction”? Is there a “best” perspective from which to view such behavior of climate? Can we distinguish the preexisting “natural” variability of climate from possible new sources of variability? How do we ensure that we have the types of measurements that we need to do so? And, how can I eat my dessert in peace with so many questions floating around in the air?

Development of New, Prototype WSR-88D Products and Algorithms

Bob Maddox, J.J. Gourley,
Jian Zhang, Chris Calvert,
and Ken Howard
WISH Group, NSSL/CIMMS
University of Oklahoma,
Norman, OK

Chuck Dempsey
Salt River Project, Phoenix, AZ

The Western Intermountain Storm and Hydrometeorology (WISH) Group of the NSSL, in partnership with the Salt River Project of Phoenix, is leading a multi-year project to improve precipitation monitoring over the Salt and Verde River Basins of Arizona. In order to meet the basic goals of the project a number of new WSR-88D analysis products and prototype algorithms have been developed. These include: 3-D Cartesian gridding of data from multiple radars, high resolution radar coverage maps for the West, an algorithm for eliminating residual (after standard WSR-88D clutter filtering) ground echo, an algorithm for identifying the height of the bright band and segregating regions of rainfall from snowfall, and an algorithm for separating convective from stratiform echo. Examples of these, and related, analyses and algorithm outputs will be shown and discussed within the context of their broad applicability to the western United States.

WSR-88D Limitations in the Western United States

John T. Ferree
Operations Training Branch
NEXRAD Operational Support
Facility
Norman, OK

Range limitations, beam blockage, and ground clutter effect all WSR-88D radars. Due to the greater distances between radars, rough terrain, and certain environmental characteristics, the consequences of these limitations are greater for radars in the western U.S. than in most sections of the central and eastern U.S. This requires operators of radars in the Western U.S. to more frequently customize the radar to minimize the impact of these limitations. This also requires users of radar data in the West to have more detailed knowledge of individual radar characteristics to make proper use of the data. This presentation will discuss radar limitations, their impact on WSR-88D radars in the western U.S., techniques to deal with these limitations, and the need for educating users of WSR-88D data.

Challenges Facing Media Forecasters in the Northern Rockies

Eric W. Gardner
KTWO-TV, Casper, WY

The weather segment within a local television newscast captures more interest and volume of viewers than any other segment of a newscast. This is according to many audience research surveys conducted by various television consultants throughout the country. In “weather-sensitive” states, such as Montana and Wyoming, where weather conditions play an important role in the economy, travel, and day- to-day life, viewers demand, accurate, up-to-date information.

Unfortunately, in both Montana and Wyoming, there are several challenges facing television meteorologists and weather presenters that make the delivery of forecasts, warnings, and other vital weather/climate information difficult. These challenges largely center around the burdens of small market television pervading all television markets in Montana and Wyoming. From staffing constraints to lack of meteorological knowledge of presenters, to equipment shortfalls, providing the information the public demands can be challenging. This presentation will detail these specific challenges, plus offer some solutions, which include some insight into how the garnering of productive relationships between local TV stations and National Weather Service offices can improve the dissemination of weather information to the viewing audience.

Natural Disaster Information Cards for Emergency Dispatchers

John F. Weaver
CIRA, Colorado State
University, Fort Collins, CO

Normally, when someone has an emergency and needs help, they can call the 911 center and dispatchers will quickly send help from the police, paramedics, or fire department. But during a natural disaster there are many people requesting help, and thinly stretched emergency responders may be significantly delayed, or might not be available to respond at all. In these cases, citizens are left to help themselves or their neighbors. They may call 911 for advice, but because natural disasters are infrequent, the correct advice for their specific problem may not be readily available. Another problem caused by the relative infrequency of these catastrophic events is the lack of experience among many dispatchers. When first exposed to the chaos surrounding a natural disaster and its aftermath, many in the emergency communications profession are surprised by the vast range of questions and requests they receive from the public. Some of the requests seem unimportant or trivial to them in the heat of the moment. Many times the questions being asked are ones they have never heard before, and ones to which they have no answers. To assist during such situations, a system called "Natural Disaster Information Cards," or "NDIC" has been developed. There are three major intended uses for the Natural Disaster Information Cards. These include:

In-service training

Refresher information on days when an event is anticipated

Real time guidance during an event

The July 21, 1999 Severe Convective Outbreak in Northeastern Montana

Eugene Petrescu
National Weather Service,
Glasgow, MT

During the late afternoon of July 21, 1999, afternoon convection over the central mountains of Montana propagated onto the plains of northeastern Montana. One particular cell near Zortman, developed into a powerful supercell which subsequently produced softball size hail in Glasgow. Another supercell formed along the outflow of the first to the east of Glasgow. These two supercells moved in tandem along U.S. 2 producing large hail and a few small tornadoes. Synoptic and mesoscale conditions that led to the development of the two supercells, as well as the organization of the convection into a well developed mesoscale convective system will be investigated. The importance of the mountain plains solenoid for enhancement of convection and the potential for gravity wave development will be addressed.

Pine Lake Tornado

Dan Kulak

Warning Preparedness

Meteorologist, Northern Alberta

Meteorological Service of Canada

Environment Canada

Shortly before 1900 MDT Friday July 14, 2000, one of the most deadly tornadoes in Canadian history struck the Pine Lake Green Acres trailer park in central Alberta. To date, twelve people have died, the most recent a hospital death in mid August, a month after the tornado struck. More than 130 were injured, and millions of dollars in property damage occurred in the trailer park. The tornado track was right through the center of the trailer park with F2 to F3 damage in a 250 metre wide corridor and F0 damage approximately 1.6 km in width based on aerial and ground surveys.

This presentation will illustrate the track of this tornado by including maps that detail damage swath boundaries, wind speed intensities, and event times. Selected photographs are used to help illustrate damage intensity near Pine Lake. Also included is a track map of the parent storm complex as it moved across central Alberta during the late afternoon and evening, highlighting locations of other reported severe weather events.

A Thunderstorm Event In Central Montana: You Make the Decision - To Warn or Not to Warn

James Brusda
National Weather Service,
Great Falls, MT

This paper is an operational review of a thunderstorm event which occurred over portions of the Great Falls County Warning Area. It will be discussed in a manner in which the attendees will determine when and what type of warning should be issued. Additional topics that will be discussed throughout the presentation will include what type of preliminary procedures should be done, along with determining the proper amount of staffing. Moreover, issues on coordination with other offices and talking with the media during and after a severe weather event will be discussed.

Areal Mean Basin Estimated Rainfall - AMBER

Gregg Rishel
Hydrologic Services Division
NWS Western Region
Headquarters

Areal Mean Basin Estimated Rainfall (AMBER) is a software tool intended to provide forecasters with an improved mechanism for evaluating potential flash flood events. AMBER methodology is based on the availability of high resolution precipitation estimates from the WSR-88D and an understanding of the small geographic scale of most flash flood events. These elements are combined to provide forecasters with information on potential flash flood events on a scale previously unavailable. Operationally, AMBER has proven to be a successful tool for identifying flash flooding. AMBER has also provided a means to be much more specific when defining areas covered by flash flood warnings.

Essentially, AMBER provides a mechanism for producing average precipitation estimates in small scale watersheds. AMBER uses the highest resolution data available from the WSR-88D, Digital Hybrid Scan reflectivity (DHR). These estimates are updated every volume scan and the results are interpreted for specific drainage basins. The precipitation estimates are compared to flash flood guidance values for the same area and graphically displayed, which allows forecasters to identify vulnerable areas. The program also has an alerting function to key forecasters to potential problem areas.

The initial version of AMBER was developed at WFO Pittsburgh PA by Bob Davis and others. This version used drainage basins which were delineated by hand from paper topographic maps. Forecasters were referred to a specific paper map by the software to determine the area which might be impacted by flash flooding. More recent versions of AMBER use GIS as means to delineate drainage basins. This provided the forecaster with the capability to view AMBER output via graphical means.

AMBER functionality is scheduled to be included in AWIPS in BUILD 5.1. NSSL And TDL are involved in this effort. Western Region has an AMBER pilot project in place at WFO Salt Lake City and another pilot project may be implemented within the region.

Effects of Wildfire on Hydrology With implications for the Upcoming Runoff Season

Steve King and Steve Gohde
Northwest River Forecast
Center, Portland, OR

Wildfire has the potential to dramatically alter hydrologic response in mountainous terrain. Hot, dry conditions of the 2000 summer combined with an excessive availability of fuels has led to one of the most extensive burn seasons experienced in recent decades. It is relevant that those within the National Weather Service flood forecasting program take note of the intensity and spatial distribution of the burned units and understand the potential implications of downstream flooding and debris flows during the upcoming runoff season. For example, a debris flow in north central Washington, following a wildfire, killed four people and destroyed several residences. Backed up by field studies, a conceptual model for streamflow response is presented. The model, which is supported by the hydrologic record following wildfire events, suggests that runoff from burned units is higher in magnitude and occurs earlier in the season than would normally occur. As a result, downstream flooding potential may be increased for several years after a wildfire. GIS tools and publicly available AVHRR satellite data provide flood forecasters with a means for identifying areas of concern.

Operational Workshop

Predicting a Complex High Plains Spring Storm

Don Moore
National Weather Service,
Spokane, WA

An early spring storm developed over southeast Wyoming and the Nebraska panhandle on April 4, 1997, and brought a wide variety of weather conditions. This storm proved to be particularly challenging to predict due to the rapidly developing nature of the synoptic and meso-scale features over complex terrain. In addition, numerical models were unable to properly forecast the evolution of this storm. As a result, close scrutiny of observations was vital to accurately predict the event. This case will be presented as an example of how to forecast a complex Spring storm with poor model guidance. Observations, particularly satellite and radar, will be emphasized throughout the presentation to 1) identify important synoptic and mesoscale features; 2) determine inaccuracies of the Eta model; and 3) recognize trends and predict the evolution of weather conditions.

This case will be presented from the perspective of an operational forecaster in a conversational manner. Observational and model data will be provided in sequential order, as if one is working on a day shift forecast desk. Using the data provided, a prediction of the evolution of synoptic and mesoscale features and their impact on weather conditions will be made. Finally, the forecast will be verified. **Audience participation is encouraged throughout the presentation,** especially while the forecast is being made.

Monitoring Weather Conditions Over the Western United States

John D. Horel,
University of Utah,
Michael E. Splitt,
NOAA/CIRP,
Lawrence Dunn,
National Weather Service
Salt Lake City, UT

A goal of the U.S. Weather Research Program (USWRP) is to improve weather observing capabilities around the nation. We are contributing to this goal by providing timely access to surface weather observations through cooperative exchange of weather information among government agencies and private firms around the western United States. Roughly 2500 stations from over 40 organizations are now included in the data base referred to collectively as MesoWest.

Examples of the use of MesoWest for National Weather Service operations will be presented. The MesoWest data are transmitted every 15 minutes over the Wide Area Network of the NWS Western Region to all forecast offices in the Western Region. The data can be displayed graphically on AWIPS workstations.

Tests are underway to broadcast surface analyses over the western United States that are based upon the MesoWest data to forecast offices every 15 minutes. The surface analyses are not competitors to 3-dimensional data assimilation systems that are used to initialize weather prediction models. Rather, the surface analyses help to visually integrate MesoWest observations and make areas experiencing significant weather easier to identify. In addition, the temporal and spatial continuity of the analyses helps to identify those MesoWest observations that are reflecting hazardous conditions as opposed to observations that may reflect poor siting or sensor errors.

Research is underway regarding data assimilation at very high resolution (on the order of 1km) over the complex terrain of the western United States. Sensitivity of the 3-dimensional analyses to resolution will be presented.

Western Network Updates: Quality Control of SNOTEL Temperature Data, and RAWS Data Access

Kelly T. Redmond
Western Region Climate Center,
Reno, NV

The Western Regional Climate Center (WRCC) maintains two major unique and regional data sets, the USDA/NRCS SNOTEL data, and the multi-agency (lead is USDI/BLM) Remote Automatic Weather Station (RAWS) data, the former as a working copy and the latter as an official archive. The principal focus of the SNOTEL network has been on the hydrologic data, even though most sites have had temperature data for the past 10-15 years, and in some cases up to 18 years. To be useful, the SNOTEL historical temperature data need quality control. A recent project at WRCC has reviewed the entire temperature record at each of the SNOTEL stations to identify erroneous data, and suggest replacement values if feasible. On the basis of withheld observations, in almost all situations, about 90-95 percent of the missing or bad values can be estimated to within 5 degrees F, even in very remote areas. The SNOTEL network is the world's largest high altitude network, and efforts should extend to making this database suitable for climate variability and change studies. The other regional network, RAWS, was originally deployed in support of fire management, but is now increasingly finding additional uses. A brief update will be given on recent efforts to greatly improve the metadata, write the data into internal formats, and provide web access to the entire database.

Meteogram Guidance Study

Beth McNulty
National Weather Service,
Glasgow, MT

Meteograms available through the Environmental Modelling Center (EMC) web page for four sites in northeast Montana were tracked over a two month period. Spot forecasts for the same four sites issued in the Glasgow public zones/verification products were compared to the model forecasts represented on the meteograms. Both sets of forecasts were verified using the office verification data. Preliminary results indicate the meteograms are a reasonable guidance product for forecasters. However, the meteogram should not be limited to providing MOS-type guidance. Further work on meteogram applications and interpretation techniques is needed. The Air Force is working on a draft technical application note which covers interpretative techniques in addition to the MOS-type guidance application. This draft will form the basis for further study to develop applications of meteograms to forecasting.

Northeast Montana Hydrology: An Overview and Methodology

David Secora
National Weather Service,
Glasgow, MT

The Glasgow Hydrological Services Area (HSA) in northeast Montana is a semi-arid region drained by two major rivers plus a smaller river with complex hydrology patterns. The combined Upper Missouri River watershed passing through northeast Montana drains a large portion of west central North America, a region with significant variations in terrain, elevation, and climate. Extensive irrigation uses of some watersheds also creates complex, and sometimes conflicting, water management patterns. Northeast Montana is a historically data sparse region, which presents significant challenges for performing NWS/GGW hydrologic operations. NWS/GGW staff have developed methodologies to synthesize hydrologic data bases from a variety of sources, especially newspaper accounts and photo records of historic floods. Photo records of all river gages, river reaches, and major reservoirs in the HSA have also been created as a reference resource. Projects under development include creation of a river ice observation network along the Yellowstone and Milk Rivers, and completion of the anecdotal history of regional hydrology, especially to identify areas of chronic flash flooding.

River Ice Jams

Charlotte Camp
National Weather Service,
Great Falls, MT

Ice jams occur primarily in the northern tier of the United States. In 1992, U.S. Army Corp of Engineers reported ice jam problems within 36 states. Ice jams are less common and more poorly documented than open water events. Due to the complex processes involved in the formation and progression of ice jams, these events are more difficult to forecast than open water flooding. Ice jam flooding is responsible for loss of life, although the number of fatalities in the United States is considerably less than non-ice jam flooding. Ice jams cause approximately \$125 million in damages annually. They can suspend or delay commercial navigation, affect hydropower operations, and damage stream channels and river structures. All of this causes a loss of revenue and potentially increases the vulnerability to non-ice jam flooding.

This presentation will review the types of ice jams, the causes of ice jams, and to show some documented ice jam events in the state of Montana.

The 1997 South Central Montana Flood Season: A Record Setter

Sally Springer
National Weather Service,
Billings, MT

Record flooding occurred over much of southern Montana during the spring of 1997. Abnormally high snowpack and a wet spring contributed to the flooding over the months of May and June as did unseasonably warm temperatures. This presentation explores the conditions that led to the flood, what actually happened, damages incurred, and the cooperation that resulted between the affected communities and the Billings National Weather Service.

Case Study of A Persistent Cold Pool in the Helena Valley

Jeff Johnson
National Weather Service,
Great Falls, MT

Many intermountain basin and valleys in the western U.S. experience cold pools, especially during the winter months. These cold pools can either be diurnal in nature, forming overnight before scouring out with daytime heating, or persistent, sometimes lasting for many days at a time. Diurnal cold pools typically form at night when cold air flows down the slopes of surrounding higher terrain. Daytime heating is usually sufficient to erode the stable layer. Persistent cold pools form primarily during the winter months when the lack of sufficient daytime heating is unable to break the inversion. Since persistent cold air pools are often accompanied by periods of low clouds and fog, an extreme safety hazard is posed, especially to aviation and other travel interests.

This presentation will discuss the synoptic and meso-scale patterns that led to the development, continuation, and destruction of a persistent cold pool in the Helena valley during December 1999. The use of supplemental observational data, along with numerical models and previous case studies, could have assisted the forecaster in monitoring the evolution and dissipation of this persistent cold pool.

A Case of Dense Fog over Southern Montana

Rick Canepa and
Mark Strobin
National Weather Service,
Billings, MT

This presentation will be a summary of conditions that led to a case of dense fog over southern Montana on November 28, 1999. The satellite “fog/stratus product” became an important tool for the forecaster to utilize for fog identification and prediction. In many instances, visibilities became extremely limited (zero visibilities) near and along the Yellowstone and Tongue River valleys during the night of the 28th. This resulted in a major impact upon aviation operations and seriously affected driving conditions at a time when traffic volume was at a peak due to the holiday weekend.

A Climatology of Freezing Rain in The Columbia Basin

Ronald J. Miller,
National Weather Service,
Spokane, WA

Ben C. Bernstein,
NCAR/RAP, Boulder, CO

Laurie Koch,
National Weather Service,
Spokane, WA

While freezing rain is a fairly common event east of the Rocky Mountains, it is relatively rare over the western United States. An exception to this is the Columbia River Basin in the Pacific Northwest (Bernstein and Brown, 1997). The topography of the Columbia Basin is ideal for trapping cold air in the lower levels ahead of warm fronts moving inland from the Pacific. Precipitation often begins as snow, changing to freezing rain as a layer of above-freezing air develops above the surface-based cold air dome. The purpose of this study is to develop a climatology of freezing rain for the Columbia Basin. Individual 1st and 2nd order station data were examined, and gridded data composites were developed to help identify the synoptic patterns which lead to this phenomenon. Subjectively the 54 events were sub-divided into 4 different categories:

Eastern Pacific Low (13 events)

Similar to Gulf of Alaska cases, but with the low farther south (i.e. south of about 50 deg N).

Gulf of Alaska Low (20 events)

Large low pressure area in the Gulf of Alaska, with broad warm advection over much of the Pacific Northwest.

Coastal Low (17 events)

Typically cyclogenesis events, with a surface low moving from the eastern Pacific to near the coast of Oregon, Washington, or southern British Columbia.

Gulf of Alaska Upper Trough (4 events)

Upper-level trough is resident over the Gulf of Alaska (typically positively-tilted) rather than an upper-level ridge along the west coast.

An Investigation of Favorable Conditions for Heavy Snow over the Washington North Cascades' East Slopes

Don Moore and Ron Miller
National Weather Service,
Spokane, WA

Moisture-laden Pacific storms frequent Washington during the cold season. Valleys in the east slopes of the Washington North Cascades, at elevations between 1000 and 2000 feet, average 100 to 200 inches of snow a year. Predicting when the heaviest snow will occur east of the Cascade Crest is a formidable challenge to forecasters due to sparse Pacific observations along with poor radar coverage and few real-time surface observations over the east slopes of the North Cascades. To better predict heavy snow for this area, more than 30 storms were analyzed over two winters. Analysis of these events revealed a high tendency for winter storms which exhibit strong westerly flow, to produce the heaviest snow. Meanwhile, strong, winter storms with low level easterly flow produced lighter snow amounts. This presentation will describe the characteristics of these two vastly different types of winter storms. The importance of low level easterly flow, typically considered “upslope conditions”, as a lifting mechanism will also be discussed.

Aviation Program

Web-based Training Modules

Beth McNulty
National Weather Service,
Glasgow, MT

Airfield Familiarization

Aviation forecasters need a working knowledge of airfield terrain to develop quality TAFs and TWEBs for the flying community. One way to gain this familiarity is with personal visits to the various airfields. Given the large distances between airports in northeast Montana, such visits are not practical. Instead, forecasters in Glasgow become familiar with airports within the CWA using a web-based training module. The training module includes topographic views of Glasgow's primary TAF sites, and those that are occasionally forecast for on a back-up basis. A short climatological summary is included in the module for each TAF site in the training module.

Aviation Outreach Web-based refresher in TAF and TWEB interpretation

One of the discussions at the recent Aviation Workshop centered on how to increase pilots understanding of the TAF and TWEB products. At that workshop it was suggested than an outreach program which included brief refreshers in reading and interpreting the products be conducted by various offices. Given that it is sometimes very difficult to gather all local pilots together, or match schedules with the regular meetings of local pilot associations, the Glasgow office developed a web-based refresher course in TAF and TWEB interpretation. There is a slave terminal at the Glasgow airport terminal for pilots to use to review the weather for flight planning, before they get their official briefing from FSS. It is simple to link the tutorial to the slave page for the pilot's convenience, as well as provide links to the tutorial via the aviation page on the Glasgow web site.

The Halloween 1999 Northeast Montana Firestorms

Eugene Petrescu
National Weather Service,
Glasgow, MT

During the late afternoon and evening of October 31, 1999, a powerful cold front swept through eastern Montana. Post-frontal winds sustained over 50 mph, with gusts in excess of 80 mph, produced minor structural damage throughout northeastern Montana. More importantly, the powerful dry winds fanned several large range fires across the region. The fast-moving fires burned in excess of 150,000 acres in just over 5 hours. One fire, ignited by a train, quickly burned through the town of Outlook, devastating the small community. A very wet growing season followed by an unseasonably warm, dry October, led to an abundance of dry fine fuels. Synoptic conditions that led to the high winds will be investigated. The use of satellite imagery to locate and track the fires at night will be demonstrated.

Hydrologic Verification in Western Region

Gregg Rishel
Hydrologic Services Division
NWS Western Region
Headquarters

Performance measures of all National Weather Service(NWS) forecasts are a high priority of NWS management. Such information is highly desirable as an indication of the level of our current services and as a baseline to evaluate future efforts. Verification data can also provide information which can be utilized to direct resources toward improving forecast capabilities.

Verification for the NWS hydrology products is in it infancy. A national program is in progress to verify the River Forecast Center stage forecasts at selected locations. A national verification scheme for WFO river flood warnings is under development and should be in place by the beginning of 2001. Western Region Hydrologic Services Division (WRH/HSD) has begun a project to develop comprehensive verification schemes which cover all aspects of the hydrology program.

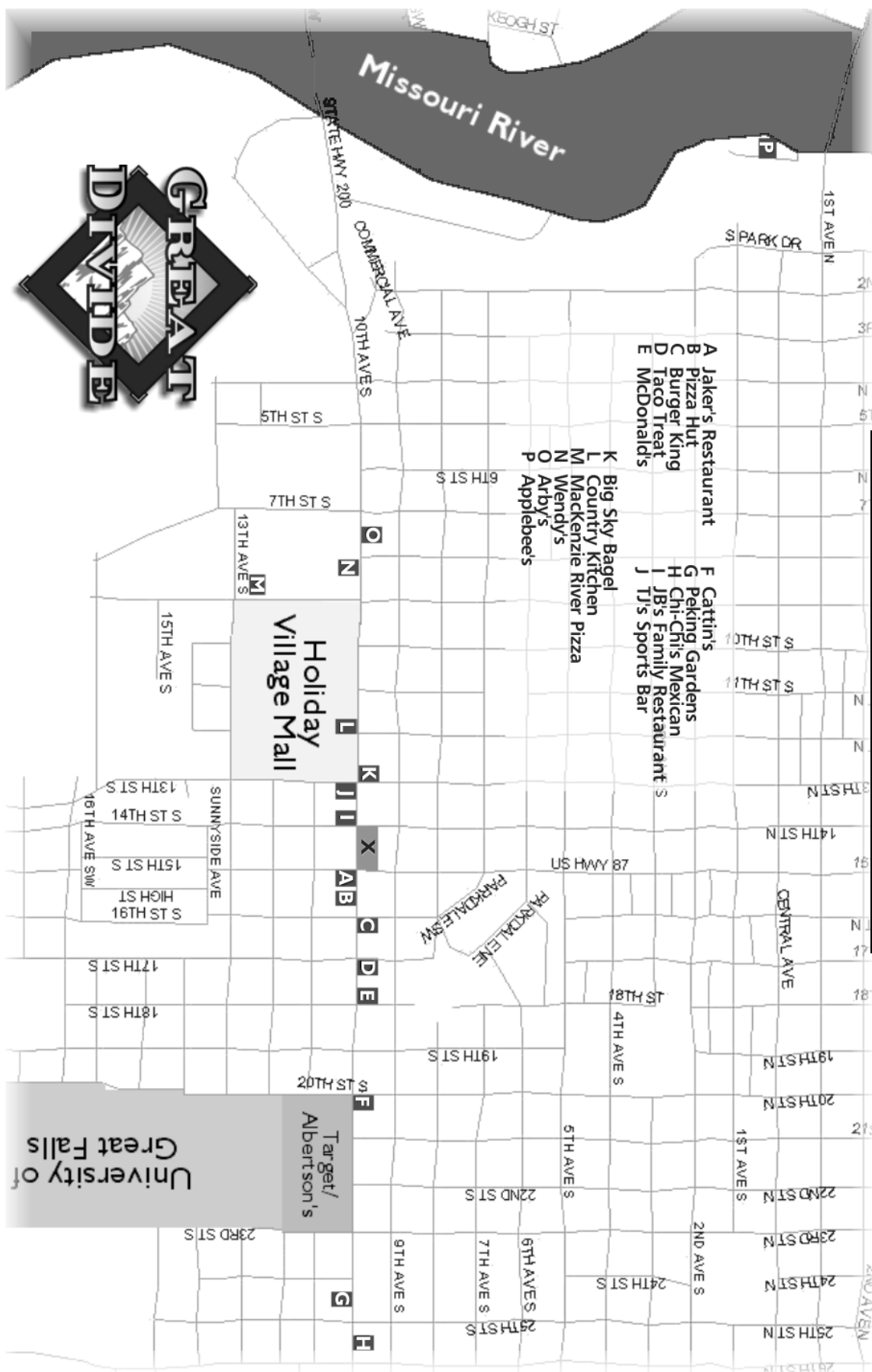
The first phase of the Western Region hydrologic verification program will measure WFO river flood warnings. This phase will utilize the WFO Hydrologic Forecast System (WHFS) database and measure basic skill in issuing river flood warnings. Software to perform this phase is near completion and it is hoped that it can be implemented before the end of this calendar year.

The next verification program will be developed for: 1)flood products at locations other than official river forecast points, 2)forecasts for flood crests and times to exceed flood stage, and 3)revamping the national stage forecast verification to provide useful local feedback at all river forecast locations. The ultimate goal of the Western Region hydrologic verification program is to provide information which can be used at the national, regional, and local levels to improve all NWS hydrologic products and services.

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Restaurants and Eateries



Notes

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This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

